U.S. Army Corps
of Engineers

Explore 6

The California Coastline
The Sacramento-San Joaquin Delta

The Year of the Coast

The beauty and physical diversity represented by California's coast, bays, deltas and estuaries are exceptional. Uniquely spectacular scenery features mountains dropping steeply to rocky shores, fertile marshes, wide beaches, rolling hills and coastal bluffs.

The sea is the coast's chief architect, and continual changes take place as waves, rains and winds reshape shoreline contours. Currents and tides continually refresh and nourish coastal lands and waters, where life forms are as diverse as their habitats. Here the tiniest of organisms and fragile plants, the mighty whale and the towering redwood all live together with man in an intricately balanced state of interdependence.

The coast—its bays, deltas and rivers—means something different to each individual. Some cherish the opportunities for contemplative solitude, the refreshing salt air and the sea breezes. Others enjoy these waters and lands as a place to picnic and swim, to fish, sun and sail, while many choose to search for driftwood or study the mysteries of rocky tide pools. Many choose bird-watching in coastal bays, marshes and deltas, while others value the potential for commercial and recreational development.

To the U.S. Army Corps of Engineers, California's delta regions and coastal areas mean a continuing dedication to management and preservation through effective engineering, exercise of regulatory authorities, flood prevention and water quality control, harbor development and protection, and conservation of fish and wildlife.

To assist you in developing a greater knowledge and appreciation for California's coast, bay and delta areas, the Corps of Engineers has prepared a series of brochures which highlight both natural and man-made features. The sites included in each brochure were selected for their unique scenic significance, recreational opportunities and accessibility. Related information on various natural phenomenon such as tidal action, beach formation and movement of currents has also been included, along with reference to numerous indigenous plants and animals. Such detail provides the visitor with the opportunity to gain an increased understanding of the many enchanting aspects of these ecologically-fascinating areas.

Bring your camera and binoculars, your curiosity and sense of adventure, and join us in exploring nature's wonderful gifts.

Sacramento-San Joaquin Delta

The Sacramento-San Joaquin Delta is a place of subtle beauty and rich natural diversity. Some 275 species of wildlife dwell in the Delta's lazily winding waterways, luxuriant marshes and gently rolling grasslands. This is truly a nature lover's paradise, even though much of the region has been transformed by man.

The Delta was once a huge marsh formed by the confluence of several large rivers, including the Sacramento and San Joaquin. From the marsh waters grew a rich variety of rushes, reeds and cattails that slowly decayed and dropped to the ground. Over thousands of years, as the sea level slowly rose, the accumulation of these decomposing plants formed peat soils, as deep as 60 feet in some places.

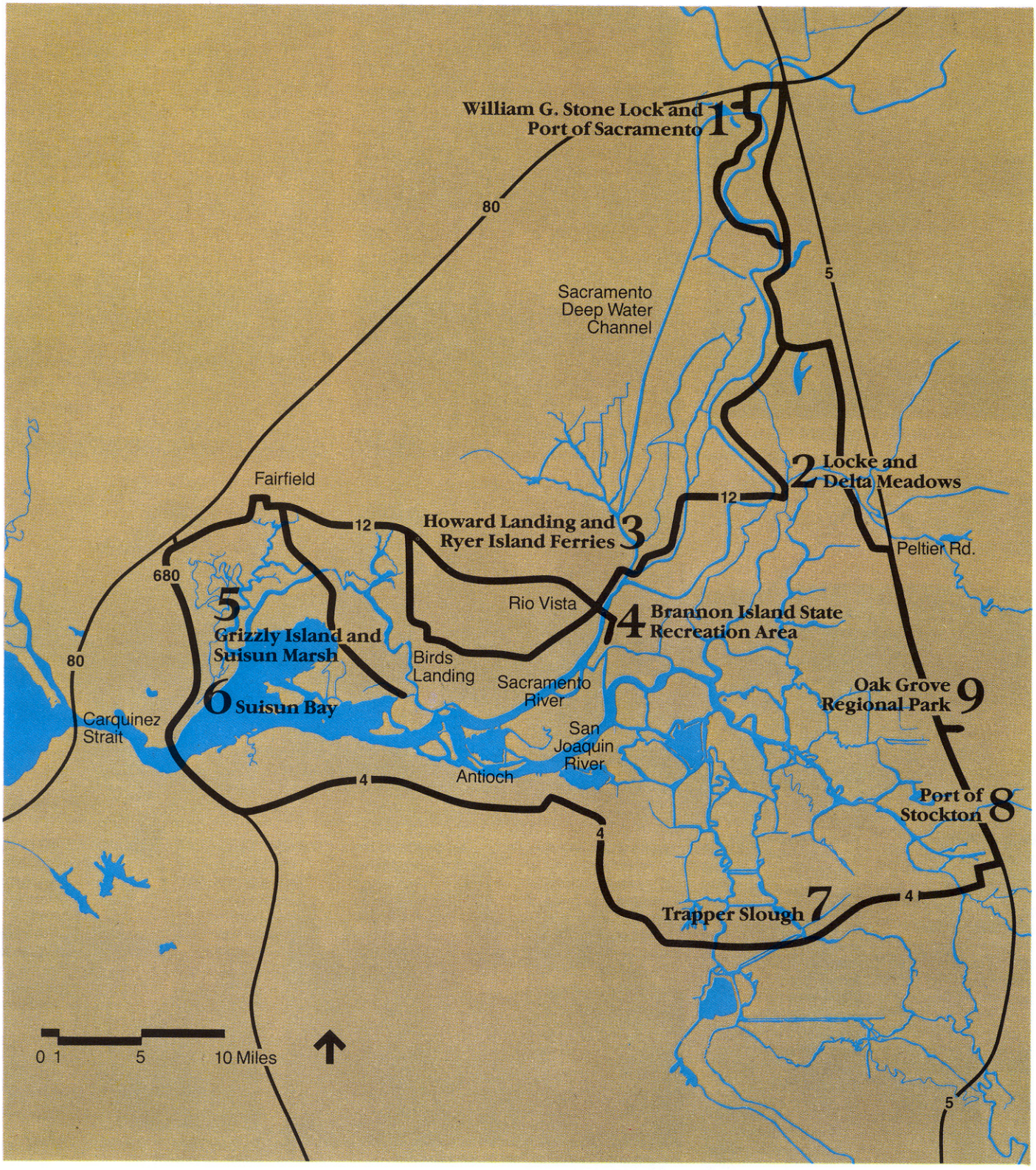
From the edges of the marsh spread a vast flood plain that once supported thousands of acres of Valley Oak woodlands. Beyond the great oaks, a few feet higher in elevation, stretched the immense prairie of the Central Valley. This area was home to huge herds of elk, deer and antelope, as well as the grizzly bear. In the fall and winter, the sky over the prairie was sometimes darkened by the millions of waterfowl making their way south along the Pacific Flyway.

For several thousand years, the Delta lands supported several tribes of Indians. The largest of these groups was the Plains Miwok, a tribe of hunters and gatherers who numbered an estimated 30,000. Following limited Spanish and Mexican occupation, fur trappers and adventurers began to explore the region. They were succeeded by settlers, many of whom came to make their fortunes in the Sierra Nevada gold fields and stayed to become farmers.

Today, most of the region's prairies and Valley Oaks are gone, replaced by the seemingly endless fields of crops that have earned the Central Valley its reputation as the "food basket" of California. In the Delta, which was once open marsh, man-made levees have created some 60 islands, surrounded by nearly 700 miles of waterways, forming one of the state's most popular aquatic playgrounds. The rich peat soil of many of the islands yields impressive harvests of asparagus, tomatoes, corn and pears.

Despite the changes man has made here, a wealth of natural beauty still remains. More than 1.5 million migrating birds, including the graceful whistling swan, arrive here each year on their way to warmer climates. A herd of tule elk, a native California species of which only 1,000 remain, survive in the Grizzly Island Wildlife Management Area. And in the clear, warm waters of Trapper Slough, bluegill swim. Complementing this rich, natural legacy is much living history, including Locke, the only remaining rural American town founded by Chinese immigrants.

The Corps of Engineers hopes that this brochure will serve as a useful guide to this beautiful and environmentally important area.


William G. Stone Lock and Port of Sacramento 1
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Sacramento Deep Water Channel
2 Locke and Delta Meadows
Fairfield
12
Howard Landing and Ryer Island Ferries 3
Peltier Rd.
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Grizzly Island and Suisun Marsh
Rio Vista
4 Brannon Island State Recreation Area
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Birds Landing
Sacramento River
Oak Grove Regional Park 9
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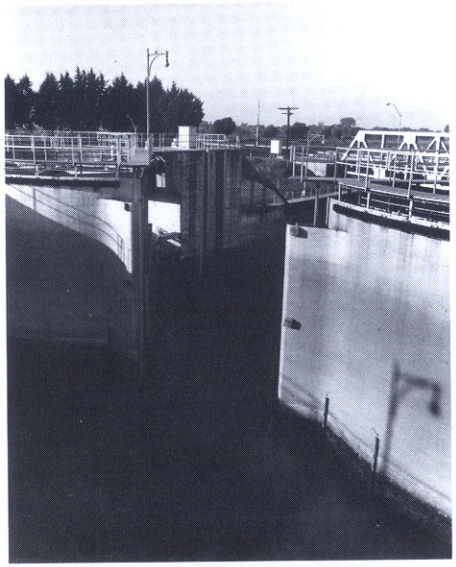


Gates opening at Lock's western end

1 William G. Stone Lock and Port of Sacramento

To reach the William G. Stone Lock from Sacramento's historically rich Old Town, proceed across the Sacramento River on the Tower Bridge. Exit at West Capitol Avenue, then turn left onto South River Drive. At the intersection of South River Drive and South River Road, turn left and continue to the lock's public viewing area.

William G. Stone Lock is 600 feet long and is the only navigational lock in California. It connects the Sacramento River with the Sacramento River Deep Water Ship Channel and the Port of Sacramento. Gates at either end are opened and closed as necessary to control water levels, allowing vessels to move from the usually higher Sacramento River to the ship channel.

During 1965, a peak year for barge traffic, approximately 1.7 million tons of commodities such as sand and gravel were transported through the lock to the San Francisco Bay area via the ship channel. In recent years, however, barge traffic dropped as shippers switched to overland modes of transportation. Now the lock is used almost exclusively by pleasure craft.

To reach the Port of Sacramento from the lock, return north on South River Road, then turn left at 15th Street and left again at Jefferson Boulevard. Follow Jefferson to Stone Boulevard and turn right. Stone Boulevard becomes Industrial Boulevard, which runs parallel to the port. At Harbor Boulevard, turn left into the port facility. A self-guided tour is available here every day of the week.

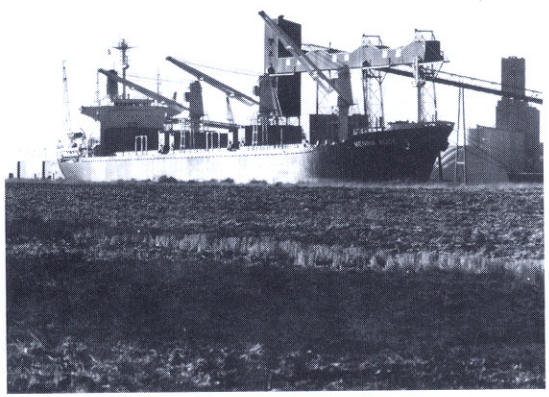
Sacramento has been a major Delta port since the days when paddle-

Pleasure boats passing through William G. Stone Lock

Sacramento Deep Water Channel as seen from levee road near Freeport

Delta Conditions

Many Delta roads run along the tops of levees. They are typically narrow—adequate for passenger vehicles and some trucks but often unsafe for larger vehicles. Winter weather can sometimes create hazardous driving conditions in the Delta region, especially during the months of December and January when dense marsh fogs can often limit visibility to only a few feet. It may be advisable to check road conditions by calling one of the Delta marinas or the California Highway Patrol. It also may be wise to bring a warm sweater or jacket. Even when days are warm in Sacramento or Stockton, it can be cold and windy in the Delta.



Freighter anchored at Port of Sacramento

Wood chips being readied for bulk cargo shipment

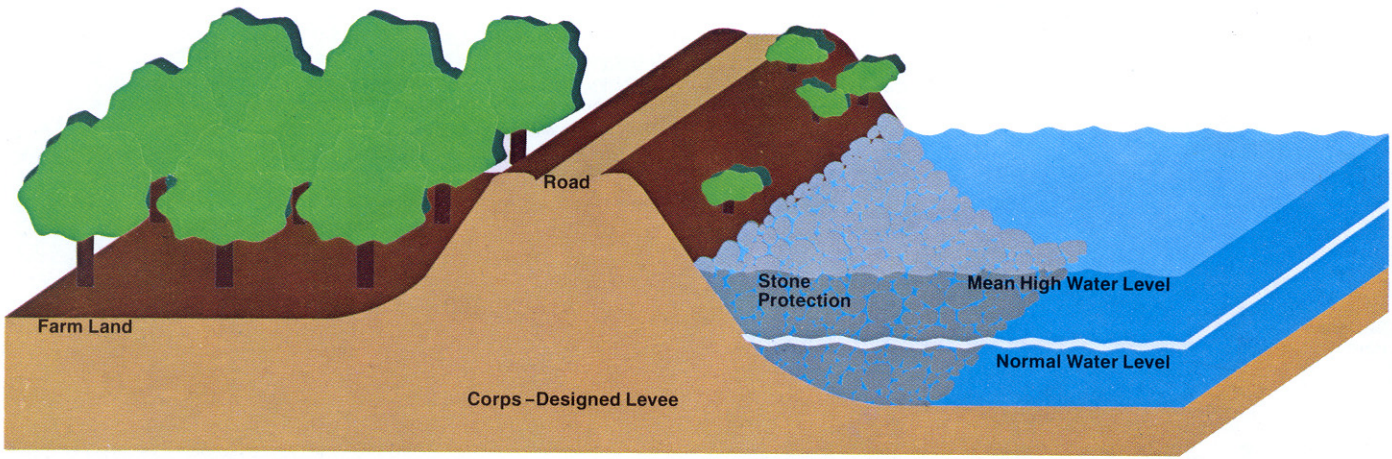
wheel and sidewheel steamboats plied the Sacramento River. These shallow-draft boats were able to safely navigate the river, which was no more than a few feet deep during dry seasons.

In 1869, the completed transcontinental railroad began to divert shipping business from the steamboats, resulting in a gradual decline in the port's fortunes. It was not until 1947 that a port commission was established to revitalize Sacramento's commercial navigation facilities. With the construction of the Sacramento River Deep Water Ship Channel, the port was made accessible to deep-draft vessels. New facilities were also built, incorporating some of the nation's most modern systems for handling such bulk cargoes as wood chips, grain and fertilizer. At the present time, the Corps of Engineers is proposing deepening the Sacramento Deep Water Channel from its present 30-foot depth to 35 feet, to allow larger, more efficient ships to call on the port.

Within the last 50 years, construction of deep ship channels has brought Sacramento and other Delta ports into the mainstream of commerce. All deepwater channels are routinely dredged by the Corps to remove river-carried sediments that would otherwise restrict commercial navigation.

To continue the Delta tour, backtrack on Industrial Boulevard to Jefferson and turn right. Immediately after crossing the lock, make a left turn onto South River Road and continue for about 10 miles to the Freeport Bridge. Cross the bridge and turn right on Highway 160. Between the Freeport Bridge and the town of Locke, the road runs along the top of levees constructed by the Corps of Engineers as part of the Sacramento Flood Control Project. At various locations along the river bank are areas protected by rock which were constructed by the Corps to prevent levee erosion. In many of these areas, vegetation has been retained or enhanced by transplanting native plants wherever possible. Much-needed recreation facilities have also been constructed.

Corps' bank protection program in progress along Steamboat Slough



Land Reclamation and the Levee System

Before 1840, explorers and fur-trappers were the only visitors seen by the Delta's native Indians. The Gold Rush brought an influx of immigrants, creating a demand for agricultural products. A few determined settlers realized the potential of the Delta's rich peat soil and began to reclaim the marshy wetlands for farming.

The earliest reclamation efforts, called "shoestring levees," were simply mounds of earth piled high to hold back flood waters. Later levees consisted of two parallel walls built of peat blocks and filled with available materials. In 1893, the *clamshell* dredge was introduced. This excavating machine, named for its hinged, clamshell-shaped jaws, reduced the need for human labor and hastened the reclamation process. By the early 1930s, about 400,000 acres of farmland had been reclaimed. Because these reclaimed tracts are totally surrounded by water channels, they are commonly called islands.

The Delta's levee system has always been fragile because peat provides a weak foundation. In fact, early levees failed regularly during flood seasons. Early efforts to strengthen them consisted primarily of building new levees on top of the old. As a result, some of the Delta's oldest levees are 100 feet wide at the base and from 25 to 30 feet high.

In addition to the problem of peat's inadequacy as a foundation, erosion, seepage, and subsidence also contribute to levee failure. This erosion is caused by daily tides, winds, waves, boat wakes and flooding. The seepage results from the passage of water through the porous peat into protected land tracts. Subsidence, a sinking of the earth's surface, is caused here by the oxidation and subsequent wind erosion of the dry peat soil.

Failure of one levee, and the subsequent flooding of the tract it protects, can create a domino effect, causing other levees to give way. In addition, the flooding of tracts can cause water quality problems throughout California's water transportation system. The California Department of Water Resources and the Corps of Engineers are jointly studying the feasibility of alternatives for flood control within the Delta.

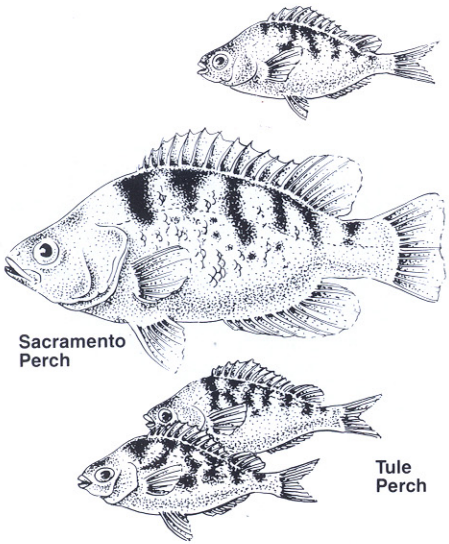
2 Locke and Delta Meadows

As the only remaining rural American town built by Chinese immigrants, Locke provides a fascinating glimpse into the past. The Chinese, like tens of thousands of others from all over the world, came to California in the 1850s hoping to make their fortunes in the gold fields of the Sierra Nevada. When they arrived, however, local discriminatory laws prevented them from mining. Many found work as laborers on the transcontinental railroad. When the railroad was completed, some began working on levee construction projects in the Delta.

The Chinese were often restricted to certain districts of the towns and cities in which they settled. The result was the creation of many Chinatowns throughout Northern California, such as the one in Walnut Grove. In 1915, when Walnut Grove's Chinatown burned to the ground for the second time, the town's Chinese merchants decided to move. A lease was negotiated with the owners of the nearby Locke Ranch. Over the years, the town of Locke grew to a population of more than 1,500, with a theatre, school, six restaurants, a hotel, temple, bakery, and several stores selling herbs, fish and general merchandise. Many of the original two- and three-story wooden buildings still line the town's Main Street.

Immediately south of Locke is a paved road that runs parallel to the Delta Cross Channel, an important part of the water transportation system supplying California's water needs. A two-mile walk north along the abandoned Sacramento Northern railroad tracks begins here. Along the way are excellent views of one of the area's most

Looking down Locke's main street



Freshwater Delta Fish

Most of the Delta's best-known freshwater fish species were introduced into the region during the late 1800s. Among these are such game fish as channel, white, black, and brown catfish, bluegill and green sunfish, white crappie and largemouth bass.

Two native Delta fish still occasionally seen are the tule perch and the Sacramento perch. The tule perch is unusual because it is one of the few fishes native to the Delta that bears live young. The Sacramento perch was the only warm-water game fish in the Delta before the introduction of other species.

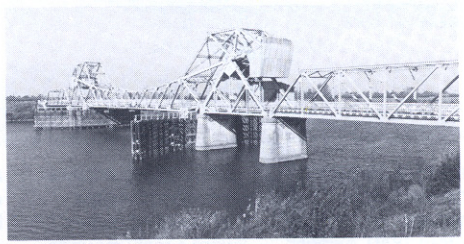
Delta Bridges

There are approximately 70 bridges in the Delta. Many are drawbridges that open to allow the passage of waterway traffic. Drawbridges are typically one of three types: *swing, bascule,* and *vertical lift.*

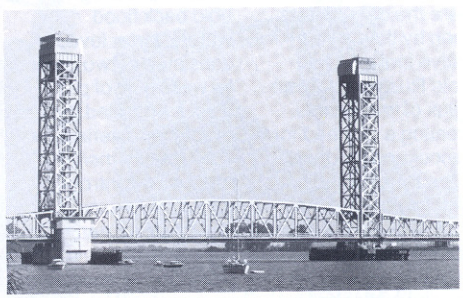
Swing bridges, like the one south of Walnut Grove on Georgiana Slough, pivot around a center support to leave the waterway clear. Bascule bridges, which separate in the center, are raised by large counterweights at the streambank ends.

One of the most unusual of the Delta's bascule bridges crosses Georgiana Slough, between Tyler and Andrus Islands. This abandoned railroad bridge is continuously kept open and can be seen rising dramatically into the sky from miles away. The most efficient drawbridges in the Delta are vertical lift bridges like the Rio Vista Bridge. Identifiable by a pair of high towers, the vertical lift bridge opens and closes much faster than the other types.

Swing bridge



Bascule bridge

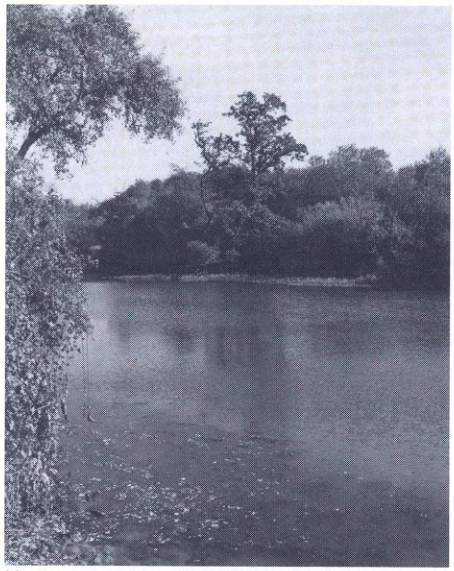


Vertical lift bridge

scenic resources, Delta Meadows.

Delta Meadows is a particularly fine example of a *riparian,* or riverbank, habitat. The area is also an excellent bird-watching site. Some three dozen species of resident birds can be seen here, including the common flicker, American kestrel, rufous-sided towhee, common yellowthroat, and belted kingfisher. During winter months, the Meadows is a stopping point for many birds migrating along the Pacific Flyway.

To reach the next site, return to the river road and cross the Delta Cross Channel to Walnut Grove. Cross the bridge over the Sacramento River to Grand Island, and turn left to continue on Highway 160. Grand Island was first settled by Reuben Kercheval in 1850. Kercheval, with the help of the Maidu Indians, built what is believed to be one of the first levees in the Delta.



Vista of Delta Meadows from railroad tracks east of Locke

About 1.5 miles southwest of Walnut Grove is the town of Ryde. During Prohibition, the Ryde Hotel was a Delta speakeasy with a secret tunnel leading from the basement to a moonshiner's still 150 feet away. Today, visitors can enjoy the atmosphere of a bygone era in the hotel's basement restaurant. From Ryde, drive west to the ferry crossing at Howard Landing.

Water Management System

About two-thirds of California's water needs are partially met by an intricate water management system of dams, channels and aqueducts. This system is designed to deliver water to the state's water-deficient areas. Because of California's variable weather patterns and the high demand for water, the system is extremely difficult to manage. Irregular rainfall, including major droughts and floods, is balanced to avoid adverse impacts. For example, insufficient freshwater flows into Suisun Bay in the past resulted in salt-water intrusion into the Delta. If these conditions occurred today, water would become too salty for either drinking or irrigation.

Among the water-management landmarks in this region is the Delta Cross Channel, between Locke and Walnut Grove. This waterway was built to direct part of the Sacramento River flows to another portion of the Delta so that higher-quality river water would flow further south to an aqueduct system extending to the city of Riverside, southeast of Los Angeles.

Delta Cross Channel near Locke

3 Howard Landing and Ryer Island Ferries

Howard Landing is the point of departure for the "J. Mack," one of several cable ferries remaining in the Delta. The 62-foot ferry pulls itself across Steamboat Slough to Ryer Island by a cable attached at either side of the slough. When not in use, the cable rests on the bottom of the waterway to prevent interference with boat traffic.

After crossing Steamboat Slough on the "J. Mack," turn left on the levee road and proceed south along Steamboat Slough-Ryer Island Road. Continue to the southern end of Ryer Island, to the Ryer Island Ferry landing. The "Real McCoy," the only cable-free, pilot driven ferry remaining in the Delta, docks here. It crosses Cache Slough, a major commercial navigation route to and from the Sacramento River Deep Water Ship Channel. Since no cables are involved in the ferry's operation, deep-draft vessels can safely navigate the slough.

Tules along Delta slough

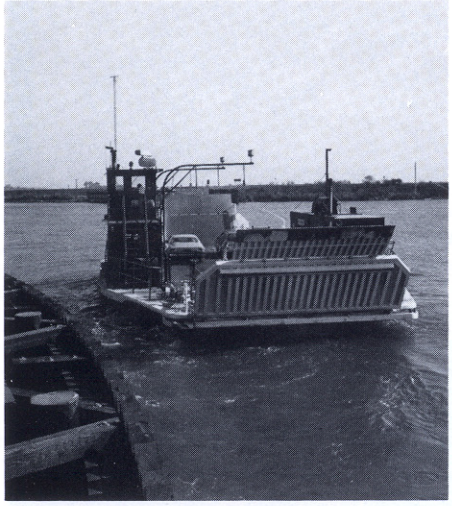
After crossing on the "Real McCoy," turn south toward Rio Vista. At the intersection of the levee road and Highway 12, cross the Rio Vista Bridge. Turn south on Highway 160 to reach Brannan Island State Recreation Area.

4 Brannan Island State Recreation Area

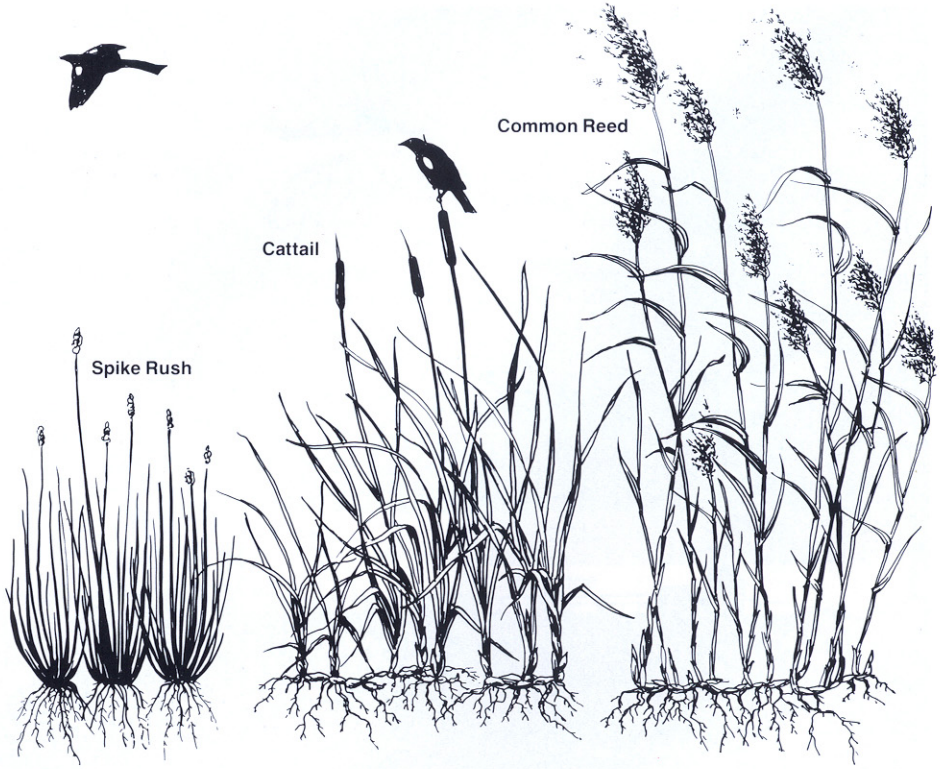
Brannan Island was first settled in 1852. In the 1920s, it was enlarged to its present size by the Corps of Engineers with land fill composed of dredged materials. Near the southern end of the island is the entrance to Brannan Island State Recreation Area, a pleasant spot for camping and picnicking.

Much of the vegetation here has been planted, including the Antioch evening primrose, an endangered species transplanted from its native habitat, the Antioch Dunes, a few miles away. The burrowing owl, which often builds its nest in ground squirrel burrows, is a local resident. Among the birds sighted here are the western meadowlark, red-tailed hawk, pheasant, loggerhead shrike and flicker.

The "J. Mack," one of several cable-driven ferries



The "Real McCoy," the last piloted ferry on the Delta



Tules

Emerging from the delta waterways is a variety of reed-like plants known as tules. Although Spanish explorers used the word when referring to marshes, tule is now commonly used to describe the tall, tubular marsh vegetation. Scientifically, the word *tule* refers to only two plants: the common tule *(Scirpus acutus)* and the southern tule *(Scirpus californica)*. However, in the Delta, cattails, common reeds and rushes, of which the most visible is the spike rush, are among those plants commonly called tules.

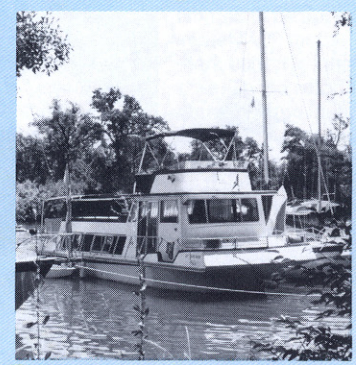
Visitors to Brannan Island may note a low structure of pipes near the entrance roadway. These pipes are visible evidence of the Delta's extensive natural gas industry. Known natural gas reserves in the Delta are estimated to be sufficient to supply the entire United States for approximately six months. The gas is found in natural reservoirs located from one-half to two miles below the earth's surface. When a natural gas well is drilled, the gas rushes to the wellhead and then moves through a vast underground piping system to various storage areas. Along the route, an additive is pumped into the otherwise odorless gas, creating the familiar, detectable smell. In fact, this additive is pumped into the pipeline on Brannan Island.

To reach Grizzly Island, the next site, return north on Highway 160 to Highway 12, cross the Rio Vista Bridge again and proceed to the town of Rio Vista. In the hills north and west of Rio Vista, in a roughly triangular area bordered by Highway 12, Highway 113 and the tracks of the Sacramento Northern Railroad, are many natural depressions called "vernal pools." These clay-lined pools collect winter rain that gradually evaporates as summer heat parches the land. Yellow and white alkaline rings are left behind. The pools contain unique, complex and ever-changing plant and animal communities.

In Rio Vista, turn right at Front Street and right again onto Main Street. Turn left on Second Street and continue through Rio Vista to Montezuma Hills Road, which meanders through the lovely, rolling grasslands known as the Montezuma Hills. At Bird's Landing Road, turn left to reach Bird's Landing, a busy shipping center during the 1860s. In Bird's Landing, turn right on Shiloh Road. Follow Shiloh to Highway 12, turn left to Grizzly Island Road, and then turn left again. Continue to the Grizzly Island Waterfowl Management Area headquarters, where information is available on which portions of Grizzly Island are open to visitors.

Sevenmile Slough, adjacent to Brannan Island State Recreation Area

Water-skiing, a popular pastime



Delta houseboat

Safe Boating Tips

More than 700 miles of navigable waterways in the Delta create the setting for one of California's most popular recreational boating areas. A variety of craft, including houseboats, can be rented at a number of landings scattered along the water's edge. Charts showing the Delta's channels, water depths, hazards and obstructions are available through numerous local, marine-oriented businesses. In addition, pamphlets on boating tips can be obtained from the Corps of Engineers Public Affairs Office and from the California Department of Boating and Waterways, both in Sacramento.

Boaters should keep several points in mind:

The Delta's currents and water depths vary with the tides. Remember to periodically check anchor lines and tide tables to determine depth variations.

Shallow and deep water areas are shown on nautical charts. Boaters can also judge water depths by observing the surrounding environment. For example, water is typically deep on the outside of waterway curves and shallow on the inside. Vertical mudbanks and levees without water-line vegetation generally indicate a deep water shoreline. Exposed sandy beaches and shoals with growing tules indicate adjacent shallow water areas.

In spring and summer, strong afternoon winds are common, causing unsheltered areas to become rough and occasionally dangerous. For wind protection, anchor on the lee side of islands with tall trees or brush.

Continuous Delta weather information is broadcast on 162.40 MHz (VHF-FM).

Grasslands of Brannan Island

Vernal pool near Rio Vista

5 Grizzly Island and Suisun Marsh

At times, more than a million migrating ducks, geese, swans and other waterfowl can be seen resting in the Grizzly Island Wildlife Management Area, a portion of the 85,000-acre Suisun Marsh complex.

In the center of Grizzly Island is a strip of grassland frequently visited by a herd of tule elk. Eucalyptus trees also grow in the center of the island, providing rookeries, or breeding and nesting areas, for the great blue heron and great egret. Occasionally seen here are the river otter, beaver, mink and muskrat.

Early farmers who built levees in this area found the reclaimed land too salty for any crop but potatoes. Eventually, the levees were abandoned and the land was returned to tidal action. Today, water levels are controlled to encourage waterfowl diversity. Hunters and others who wade in flooded areas are advised to carry a walking stick. What may appear to be solid ground can sink under pressure. This is not usually a problem in dryer portions of the Delta.

Suisun Marsh was known as "the place of the west wind" to the Patwin Indians who hunted and fished here for centuries. Before land reclamation, the entire Delta region was probably similar in appearance to Suisun Marsh. The marsh is of international importance as a major resting place for birds migrating along the Pacific Flyway. During drought years, up to 25 percent of California's entire wintering waterfowl population have gathered here at the same time.

To reach the next site, return to Highway 12 and turn left. Follow the highway to the I-80 south exit. From I-80, take I-680 to Lake Herman Road, to reach a point from which to view Carquinez Strait, the Reserve Fleet and Suisun Marsh.

Lush wetlands of Grizzly Island

Whistling Swans

Ruddy Ducks

Pacific Flyway

The Suisun Marsh and the Sacramento-San Joaquin Delta regions are major stopping points for waterfowl traveling along the Pacific Flyway, a migratory path followed each winter by birds moving south from Arctic regions. The north-south route of the Flyway tends to follow the Pacific coastline and extends inland as far east as the western edge of the Rocky Mountains.

Annually, about 9.5 million birds winter in California, some one million in the Suisun Bay region alone. Another 1.5 million pass through the state on their way to Mexico or Central America. As winter progresses, the species of birds arriving in Suisun Marsh and the Delta vary. Pintail ducks and geese begin to arrive in early fall. Pintails, among the few species that spend the winter here, sometimes comprise more than three-quarters of the birds in the marsh. Over twenty species of ducks and geese eventually utilize the area during the season. Geese continue to fly in for a much-needed rest as late as December. Many geese and ducks using the Flyway are gleaners. After pausing here in the marsh and elsewhere in the Delta to eat grain, they then continue on their route. Other bird species that use this portion of the Flyway are the loon, grebe, whistling swan, and other waterfowl.

6 Suisun Bay

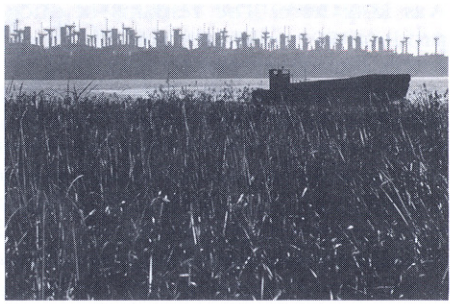
The vista point above Highway 680 provides a superb view of Carquinez Strait, the National Defense Reserve Fleet, and a portion of Suisun Bay.

Salt water moving northward through San Francisco Bay from the Pacific Ocean meets the fresh water of the Delta river system near here in what is called a "mixing zone" area. This mixing zone is critical to the ecology of the region and the statewide water system served by the Delta. Anadromous fish, which live in salt water and spawn in fresh water, pass through this area to lay their eggs in Delta waters and tributary rivers. Included are the striped bass, and American shad, which were imported to the Bay Area in the 1800s. Natives such as the white sturgeon and chinook, or king, salmon also move through the area to spawn in the fresh waters upstream of the Delta.

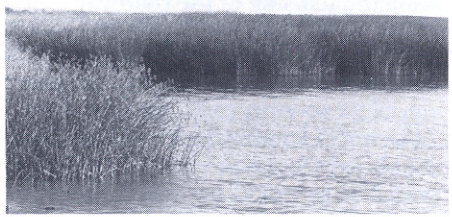
The hundred-plus ships anchored in Suisun Bay are owned and maintained by the Maritime Administration of the U.S. Department of Commerce and are part of a national system of reserve ships designed to provide military support in the event of war. When these ships are determined to be obsolete, they are sold for non-transport use or for scrap.

To reach the next site, return on Lake Herman Road and turn south on Highway 680. Cross Carquinez Strait on the Benicia-Martinez Bridge, then exit at the Highway 4 offramp to Pittsburg and Antioch.

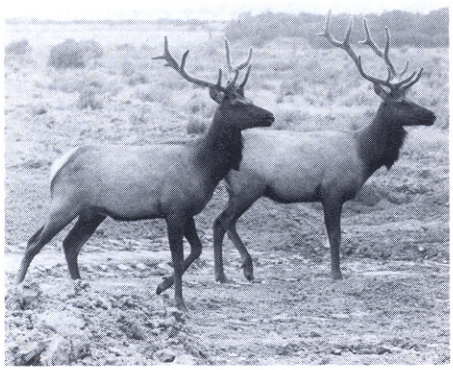
Currently, the area around Pittsburg and Antioch is a center for various heavy industries, but from 1855 until production ceased in 1902, coal



Reserve Fleet with marshlands in foreground



Wetland habitat along Carquinez Strait



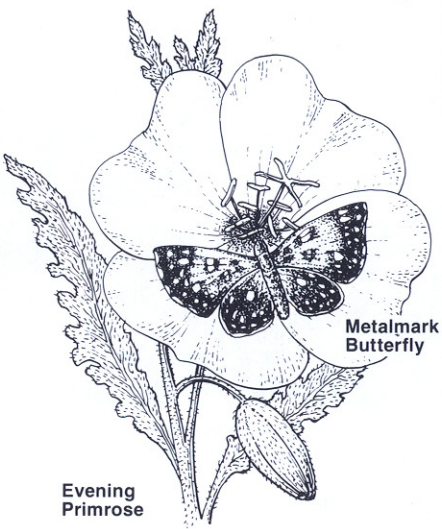
Tule Elk

The endangered tule elk, found only in California, once roamed the state in large numbers. As California's uplands and prairies were converted to agriculture, the elk's food supply diminished and the species nearly became extinct. Many people believe that only two of the elk remained when an Owens Valley rancher put them under his protection in the late 1800s. The elks' recovery was further assisted when the state took over the animal's protection in the early 1900s. In 1977, in an effort to increase the elks' numbers, the State Department of Fish and Game began moving the excess population from Owens Valley to other suitable areas, including Grizzly Island. From an original herd of six, the Grizzly Island herd grew to 33 by 1980. The statewide tule elk population now numbers nearly 1,000.

Antioch Dunes

A visit to the Antioch Dunes provides an interesting side trip for those curious about unique habitats for rare and endangered plants and wildlife. To reach the dunes, which are part of the San Francisco Bay National Wildlife Refuge, exit at Highway 160 off Highway 4. Almost immediately exit again at Wilbur Avenue and turn left. Just past the Crown Zellerbach Antioch Mill, a small Fish and Wildlife Service sign indicates the entrance to the reserve. Cars are not allowed in the area, but there is a hiking trail leading down to the water through the dunes.

This 40-acre area is a critical habitat for the endangered Lange's metalmark butterfly, the Antioch Dunes evening primrose, and the Contra Costa wallflower. There are estimated to be approximately 400 metalmark butterflies in the area. These colorful butterflies are identifiable by the orange, black and white flecks on their wings. The evening primrose, an annual plant that grows to a height of three feet, forms low, densely-branched bushes and produces large cream-colored flowers between March and July. About 1,000 evening primroses survive at Antioch Dunes, and others have been successfully transplanted on Brannan Island. The Contra Costa wallflower, of which an estimated 200 survive, is a coarse-stemmed, biennial herb that also grows to about three feet. The plant's base is relatively woody, and its yellow or orange flowers bloom between March and May.



was king here. The remains of once-productive coal mines and the boom towns that developed around them are now included within Black Diamond Mines Regional Park, located in the hills above Antioch.

After passing Antioch, Highway 4 continues through orchards, vineyards and walnut groves. Approximately 36 miles from Antioch, Highway 4 crosses Old and Middle Rivers to Roberts Island and Trapper Slough. There are several parking turn-outs along the left side of the roadway.

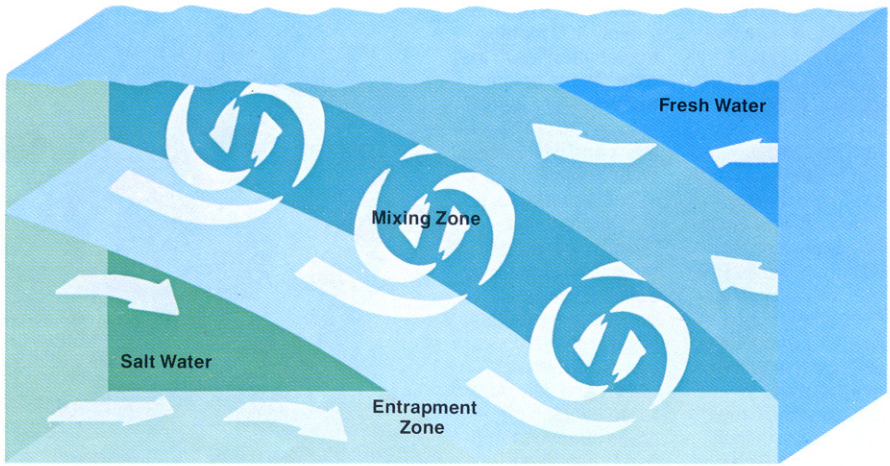
7 Trapper Slough

Trapper Slough is one of the few relatively untouched natural sloughs left in the Delta. Primarily a freshwater marsh, the slough's open water areas are lush with yellow water weed and water hyacinth. In these quiet waters, reputed to be the clearest in the Delta, swim bass, catfish, carp and goldfish. Bordering the 3.5-mile-long slough are cattails and rushes that provide cover for frogs, red-winged blackbirds, muskrats and beavers.

Over the years, the surrounding farmland has subsided, leaving the slough much higher than adjacent areas. The slough's water level is only two or three feet below the nearby roadway, for example, while the roadway is more than a dozen feet above the farmlands.

To reach the Port of Stockton, the next site, follow Highway 4 east and continue on I-5 north. Take the Fresno Avenue exit and turn right. From Fresno Avenue, turn left on Washington Street. Follow Washington until it intersects with Road 13. At this intersection is the Port of Stockton Administration Building, where information about touring the city's port facilities is available.

Portion of Trapper Slough adjacent to Highway 4

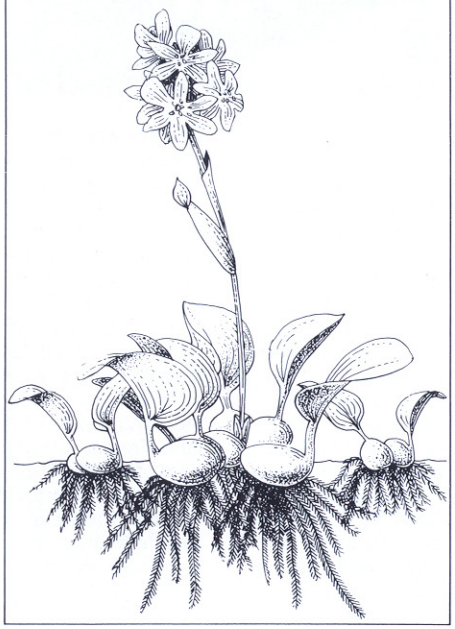


Mixing Zone
Salt water from the Pacific Ocean meets the fresh water of the Sacramento and San Joaquin Rivers in what is called the "mixing zone". Within this zone occur physical and chemical processes vital to the ecosystems of both fresh and salt water regions.

Because salt water is colder and denser than fresh they do not mix readily. However, as the fresh and salt waters meet, small eddies are produced that accomplish the mixing job. This mixing of waters causes trace minerals and other nutrients to drop into an *entrapment zone,* where they are consumed by microscopic single-celled plants called phytoplankton. In turn, the phytoplankton are eaten by zooplankton, a primary food source for many fish and the organisms on which they feed. These organisms include the opossum shrimp favored by the young of such anadromous fish as striped bass and salmon.

The location of the mixing zone is primarily dependent on the outflow of Delta waters. During the great flood of 1861–1862, for example, the mixing zone was pushed beyond the Golden Gate and freshwater fish filled San Francisco Bay. By contrast, during the 1862–1863 drought, the mixing zone moved inland as far as Stockton. Today's water management system generally confines the mixing zone to the area between Antioch and Honker Bay.

Water Hyacinth
The water hyacinth is a floating aquatic plant of South American origin. The water hyacinths visible in the Delta, most notably in the Trapper Slough area, were accidentally imported in recent years. Despite their beauty, they are considered a prolific weed which often restricts boat travel and clogs irrigation and flood control systems. The water hyacinth's effect on aquatic life has not yet been totally determined. The problem is confined at this time to the southern Delta.



8 Port of Stockton

Stockton, which was originally called Tuleburg, boomed with the Gold Rush and later became a major center of agricultural commerce. Today, more than one million tons of agriculture-related products move annually through the Port of Stockton, California's oldest inland port. Petroleum and jet fuel, among other major commodities, are handled here.

The size of ships in the world's shipping fleet has become increasingly larger. Many vessels docking at Stockton must now be "light-loaded," or partially loaded, in order to pass through the Delta's navigation channels. Congress has authorized deepening the 77-mile-long ship channel that connects the port with San Francisco Bay. The project will be carried out under the supervision of the Corps of Engineers. Dredging of about 12 million cubic yards of material will be required to deepen the existing 30-foot channel to 35 feet. The dredged material will be deposited at several locations, including three sites earmarked for construction of an 80-acre recreation site at Roberts Island and two wetland areas at now-submerged Donlon and Venice Cut Islands. The Corps of Engineers is helping to ensure that necessary wetland habitats are maintained to sustain the area's wildlife.

To reach Oak Grove Regional Park, return to Washington Street, and then turn right at Fresno Avenue. Continue to I-5 north and exit at Eight Mile Road. Within half a mile of the exit is the entrance to the park.

9 Oak Grove Regional Park

This county park contains the largest remaining natural stand of valley oaks in the Delta area. The entire Delta was once surrounded by a broad belt of these trees stretching up to two miles inland from the marshes. The oaks' acorns were valued by the Indians, who ground them into a nutritious mush. After the mid-1800s, however, settlers began clearing the trees to plant wheat. The wood was sold as fuel for the Delta steamers.

Valley oaks grow in clumps, or groves. As the trees age, their limbs droop toward the ground. In this "weeping" stage, the trees are from 100 to 300 years old. They provide welcome shade canopies from summer's hot sun.

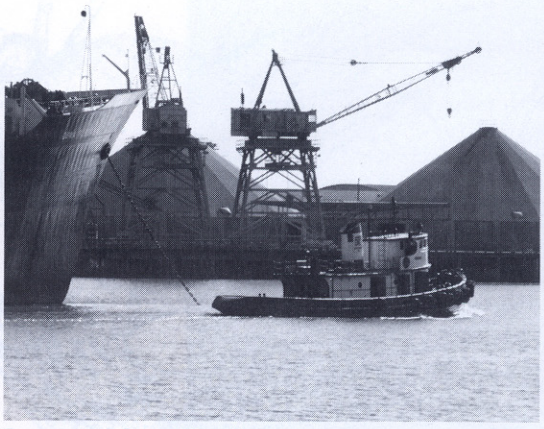
Eighty-five acres of Oak Grove Park have been set aside as a nature sanctuary. A trail accessible to wheel-

Tomato harvesting in the Delta

Agriculture

The earliest Delta agriculture dates back to the 1840s. Early farmers, known as "rim landers," raised wheat in the upland, or rim area, surrounding the Delta wetlands. In 1869, following completion of the transcontinental railroad, thousands of Chinese came to the Delta and were instrumental in building the Delta levee system. Within a few years, former marshlands were producing melons, potatoes, sugar beets, squash and asparagus.

By 1930, most Delta land had been reclaimed and the owners of large farms turned to the use of mechanized equipment. Agriculture then shifted from labor-intensive to capital-intensive crops such as corn, grain, safflower, and hay. However, one-half of the nation's annual green asparagus and almost all of its white asparagus still come from the Delta region.



Tug working Port of Stockton

Ship docked at Stockton's busy port

Fishing on the Consumnes River near Thornton

Lone horse on Delta levee

chairs affords an excellent opportunity to enjoy these remarkable remnants of the natural Delta.

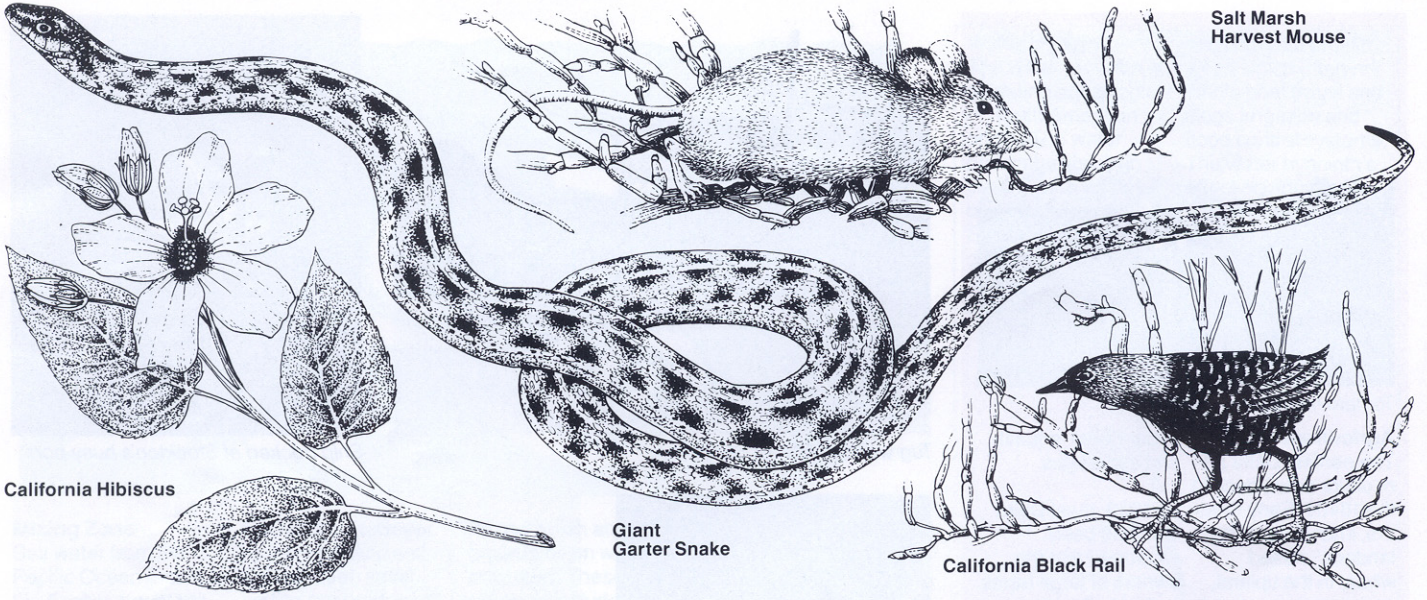
To enjoy a scenic drive back to Sacramento, return to I-5 north, take the Peltier Road offramp, and then turn onto Thornton Road. In Thornton, turn left at Walnut Grove Road, then right at Franklin Boulevard. About three miles north of Thornton, the road crosses the Consumnes River. This area is part of one of the largest riparian habitats remaining in the Delta.

The Delta's natural riparian habitat once surrounded the original marsh and its tributary rivers and streams. Trees and shrubs that thrive in this environment include the willow, Fremont cottonwood, California black walnut, dogwood, blackberry, wildrose and blue elderberry. Vegetation provides vital food, resting sites and cover for numerous wildlife species such as the belted kingfisher, red-shouldered hawk, Pacific pond turtle, muskrat and river otter.

At the town of Franklin turn left onto Hood-Franklin Road. This region is one of the oldest pear-growing areas in California. Some of these pear orchards are over 100 years old. At Hood, turn right on Highway 160 and continue north along the east bank of the Sacramento River to Freeport, a town with a colorful history.

Freeport was founded in 1862 by the Sacramento Railroad Company. At that time taxes were levied by the city of Sacramento on people and goods in transit to the gold mines. The railroad company balked at these taxes and created Freeport as a tax-free port. The railroad magnates hoped their new town would become the western terminus of the transcontinental railroad, but instead Sacramento was chosen. Even though this grandiose scheme proved fruitless, the town thrived. Freeport later attracted people of Portuguese descent who established themselves as commercial fishermen. These people were among the first to live in river houseboats.

From Freeport, continue north on Highway 160 to Sacramento. When you reach Broadway, turn left and follow the street until it nears the Sacramento River. Turn right at Front Street and return to the city's Old Town. This popular, recently renovated shopping and restaurant area contains some of Sacramento's most historic buildings.



Endangered Species

The Delta provides a valuable habitat for several rare and endangered plant and animal species. Among these are the giant garter snake and the California hibiscus, usually associated with freshwater environments. Also here are the salt marsh harvest mouse and the California black rail, which are generally found in salt or brackish water environments.

The giant garter snake can reach a length of 4.5 feet. It is one of the most aquatic of the garter snakes. Although the snake is rare, it can still be found north of Ryde, near Winchester and Stone Lakes, at White Slough, and south of Ryde, between Staten and Bouldin Island.

The California hibiscus, an endangered shrub with crimson-centered flowers, has been sighted near Hog Slough, a few miles southeast of Walnut Grove. It has also been seen south of Rio Vista on the Sacramento River, near the middle of Hog and Disappointment Sloughs, at Middle River on the East Side of Jones tract, and on Old River west of Palm Tract.

The tiny salt marsh harvest mouse has a rich brown back and whitish underparts. It is one of the few mammals whose diet includes salt water. The harvest mouse found in the Delta lives in the marshes bordering Suisun Bay, as well as on Van Sickle, Chipps and Browns Islands.

The California black rail, a secretive, sparrow-sized bird, prefers salt marsh picklewood for its habitat, but is found in freshwater marshes as far inland as Stockton.

The Year of the Coast

In keeping with President Carter's declaration of 1980 as "The Year of the Coast," the U.S. Army Corps of Engineers has joined other public agencies and private organizations in focusing attention on the need to manage, preserve and protect our nation's coastal areas. To assist in this worthwhile objective, the U.S. Army Corps of Engineers will, throughout 1980 and 1981, publish a series of brochures highlighting key natural and man-made features of the California Coast. It is hoped that this series will both inform the public of coastal features and processes and assist in the development of a greater appreciation of the critical need to insure the protection and management of coastal resources.

For additional details on these brochures and other public information and education programs available from the Corps of Engineers, please contact the following Public Affairs Offices:

South Pacific Division
630 Sansome Street
San Francisco, CA 94111
(415) 556-5630

San Francisco District
211 Main Street
San Francisco, CA 94105
(415) 556-0594

Los Angeles District
300 N. Los Angeles Street
Los Angeles, CA 90012
(213) 688-5320

Sacramento District
650 Capitol Mall
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